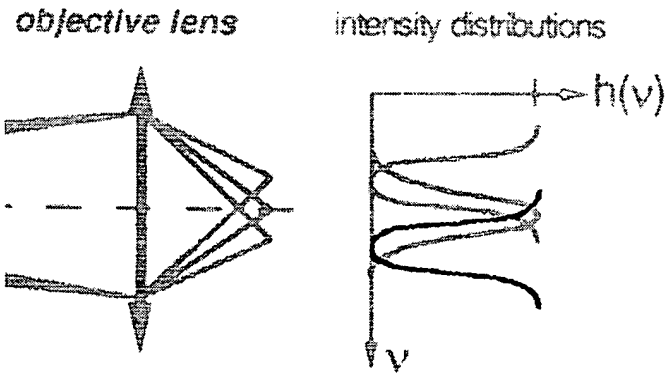
Remarks

Claims 41 and 42 have been amended to better describe the present invention. The informality noted by the Examiner in Claim 58 has been corrected.

The Examiner has rejected Claims 59 and 60 under 35 U.S.C. 102(a) in part because "The structure disclosed in the article [by Hell and Wichmann] appears to be identical to that claimed in the instant claims, so there is no reason to assume that the central minimum of the quenching radiation is anything other than substantially zero." On the contrary, Applicant will now attempt to demonstrate that the intensity at the central minimum in the device described by Hell and Wichmann is substantially greater than zero.

It should first be realized that there are only two ways that two superimposed optical patterns can summate at a particular point to have a zero intensity. In the first way, one of the patterns can have a finite intensity at that point, and the other pattern can have the same intensity at that point, but have the opposite phase, so because of destructive interference at that point, the net intensity at the point is zero. The *only other way* that two patterns can superimpose and produce a zero intensity at a particular point is if each of the patterns, *by itself*, has a zero intensity at that point.

The Hell and Wichmann (H&W) article made no mention, or suggested in any way, that the two STED beams were out-of-phase and cancelled at the plane of focus, so the first way mentioned above to produce a zero point can be ruled out. Thus the only possible way is if both STED patterns, individually, had a zero intensity at the central point. However it is clear from the article that this was not the case, and therefore the central point in the summated STED beam pattern had an intensity substantially greater than zero.



The illustration above is a detail from Fig. 2 of the H&W article, showing, according to the article, the intensity distributions of the two STED beams in relationship to the central excitation maximum. Although these curves do not make sense when the intensity distribution axis is as indicated, a comparison with similar diagrams in later publications from Hell and coworkers suggested that the direction of the intensity distribution axis was labeled correctly for the excitation beam but incorrectly reversed for the STED beams. Here, the original artwork has been copied in gray, and for clarity, one of the STED beam intensity distributions has been colored in black. The illustration shows that at the point this STED beam crosses the central axis of the excitation maximum at, its intensity is significantly greater than zero, and therefore the summation of the two STED beams at the maximum of excitation must also be significantly greater than zero. The device described by Hell and Wichmann, as illustrated in their Fig. 2, therefore has an intensity greater than zero at the central point of the superimposed STED beams.

This same conclusion can be reached by considering that on p. 781 of the Hell and Wichmann article, the STED beam is described as being spatially Gaussian. As is well known in the art, the intensity of a spatially Gaussian beam drops continuously with distance from its central maximum, assymptoting to zero, but never absolutely reaching it. Since each of the STED beams, individually, has no zero point, neither can their superimposition.

Not only does the device described in the H&W article fail to produce a minimum with a substantially zero intensity at the center, but the article does not describe such a condition as a desirable feature in order to increase resolution in the microscope. In fact the word "zero" does not appear anywhere in the article.

The article even suggests, by implication, that for maximum resolution, intensity of the central point should be *greater* than zero. The article states (p. 781-782) "We found that the resolution increases with decreasing $\Delta\nu$ which brings the beams closer to the focal point. However, the increase in resolution is associated with a reduction in maximum signal strength (Fig. 5)." Since as can be seen from Fig. 2, bringing the beams closer to the focal point will increase the intensity at the central point, the implication is that when resolution is the prime goal, the intensity at the central point would, by necessity, be greater than zero.

These comments therefore show that the device described in the H&W article lacked "...means for directing said second type of radiation to said selected region so as to preferentially decrease the excitation in a chosen part of said region, and such that the intensity of said second type of radiation on at least one point in said region is substantially zero, thereby increasing the resolution of said apparatus" as required in Claim 59 or "...means for shaping said second type of radiation into a pattern projected into said region, said pattern containing at least one point where the intensity of said second type of radiation is as close to zero as is reasonably feasible" as required in Claim 60. Therefore the Claims 59 and 60 do not read on the device described in the H&W article.

The H & W reference may also fail to meet the minimum requirements for a teaching reference under 235 U.S.C. 102(a). It has been held that "Anticipation cannot be predicated on teaching in a reference that are vague or based on conjecture" (Studiengesellschaft Kohle mbH v. Dart Indus, 549 F. Supp 716, 216 U.S.P.Q. 381 (D. Del. 1982), *aff'd* 726 F.2d 724, 220 U.S.P.Q. 841 (Fed. Cir. 1984)). This issue has been discussed more fully in Applicant's response, dated February 16, 1999, in response to the Office Action dated September 14, 1998 in application Serial Number 08/919,382. Applicant's September 14, 1998 response is incorporated herein by reference.

A Terminal Disclaimer to Obviate a Double Patenting Rejection over Patents nos. 5,952,668 and 5,886,911 has been filed herewith to overcome the Examiner's objections to Claims 41-52 and 58. It is therefore believed that all objections raised by the Examiner have been addressed in the present amendment. Allowance of the claims and issuance of the case is therefore earnestly solicited.

Respectfully submitted,

Stephen C. Baer, Applicant

Stephen C. Baer, Applicant
10 Poplar Rd. #3
Cambridge, MA 02138
(617) 547-7932

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Claim Listing

Claims 1-40 (canceled)

Claim 41 (currently amended) In apparatus for irradiating a selected region of a target material containing an excitable species in order to ~~excite~~ produce a state of excitation in members of said species, including a source of exciting radiation adapted to ~~exciting~~ producing a state of excitation in said members and focusing means to focus said radiation to said selected region, a method of increasing the resolution of said apparatus including the steps of:

providing a second type of radiation able to reduce ~~the~~ said state of excitation of said species by said exciting radiation; and

applying said second type of radiation preferentially to a chosen part of said selected region such that the net intensity of said second type of radiation on at least one point in said selected region is substantially zero, except radiation of said second type arriving on said point from sources such as scattering and reflection within said apparatus and said material, not feasible to completely eliminate, thereby increasing the resolution of said apparatus.~~to said selected region to preferentially decrease the excitation in a chosen part of said region; and~~

~~reducing the net intensity of said second type of radiation on at least one point in said selected region to substantially zero, except radiation of said second type arriving on said point from sources such as scattering and reflection within said apparatus and said material, not feasible to completely eliminate, thereby increasing the resolution of said apparatus.~~

Claim 42 (currently amended) The method in Claim 41, wherein the step of ~~reducing the net intensity of said second type of radiation on at least one point in said selected region to~~ applying said second type of radiation preferentially to a chosen part of said selected region such that the net intensity of said second type of radiation on at least one point in said selected region is substantially

zero includes the additional steps of providing a first source of said second type of radiation directed on said point, and providing a second source of said second type of radiation directed on said point, coherent with said first source, and adapted to destructively interfere, at said point, with the radiation from said first source of said second ~~time~~ type of radiation.

Claims 43-50 (original)

Claim 51 (currently amended) The method of Claim 41 wherein said radiationally excitable species are in a class including:

fluorescent molecules in a target material to be examined;

molecules in a target material to be examined that can emit radiation following excitation;

particles in a target material to be examined that can emit radiation following excitation;

molecules in a target material consisting of a recording medium encoding information;

molecules in a target material adapted to undergo a long term change in at least one property following exposure to said exciting radiation; and

molecules in a photolithographic resist.

Claims 52-57 (original)

Claim 58 (currently amended) The method of Claim 41 wherein a plurality of points are ~~imagined~~ imaged simultaneously.

Claims 59-60 (original)